International Research Journal of Engineering and Management Studies (IRJEMS)
Volume: 03 Issue: 04 | April -2019 ISSN: 1847-9790 || p-ISSN: 2395-0126

Bull's Eye:- An Eye Writer

Prithvi Singh[1],Punit Sharma[1], Rohit Bhatnagar[1], Shubham Tailang[1], Jitendra Singh[2]

[1]Dept. of Electrical Engineering, Swami Keshvanand Institute of Technology M&G, Jaipur,Rajasthan, India
[2]Assistant Professor, Dept. of Electrical Engineering, Swami Keshvanand Institute of Technology M&G, Jaipur,Rajasthan, India

---

Abstract - *The Bulls Eye is an eye tracking system originally designed for paralyzed people. With the aid of this device, the user is able to control the entire computer using their eyes. It uses a modified PS3 eye camera and IR illuminators along with specified software's to track the position of user's pupil and a drawing software that allows a user to draw with movement of eye. It is the process of measuring either the point of gaze (where we are looking) or the motion of an eye relative to the head. An eye tracker is a device for measuring eye positions and eye movement or gaze point detection. The Eye-Writer is a low cost eye tracking device. It is open source software that allows people suffering from Amyotrophic Laterals Sclerosis(ALS) which enable them to write and draw by tracking their eye movement and converting them into waveforms or any graphical form. Eye trackers are used in research on the visual system, in psychology, in cognitive linguistics and in product design. There are a number of methods for measuring eye movement. The most popular variant uses video images from which the eye position is extracted. Other methods use search coils or are based on the electrooculogram. The most broadly utilized current outlines are video-based eye trackers. A camera concentrates on one or both eyes and records their gaze point. Most present day eye-trackers utilize differentiation to find the focal point of the user and utilize infrared and close infrared non-collimated light to make a corneal reflection.*

Key Words: **Eye Writer, Eye gaze tracker, Eye Tracking, Electrooculagram, Bull's Eye.**

1.INTRODUCTION

The main objective of this project is, generally, most of the people can read and write, listen, and do anything because of their body communicates with there mind. So mind controls every moment of the body. But some of the people cannot do like this because of their body may not communicate with there brain, means the brain is active but the body is in-active. This kind of people can think but not implement their thoughts. Many scientists have researched and designed "An EYE TRACKER" for this kind of people. By using Eye tracker they can implement their thoughts; this kind of application is called "BULL`S EYE". This eye tracking is used for finding the eye moments and positions from left-to-right, right-to-left, and up-to down, down-to-up and also the location of the object. This is used for who are suffering from the neuromuscular syndrome. According to the eye movement of the people to write and draw their thoughts and translate these moments into lines on the screen.

1.1 Eye Tracking

It is the process of measuring either the point of gaze (where we are looking) or the motion of an eye relative to the head. An eye tracker is a device for measuring eye positions and eye movement. Eye trackers are used in research on the visual system, in psychology, in cognitive linguistics, and in product design. There are a number of methods for measuring eye movement. Eye Tracking is of three kinds: • First one is the magnetic field sensor or special contact lenses (which are made by the embedded mirror) are attached to the eye and this sense or mirror is around the eyeball. It does not slip when the eye rotates. The first tracker is used for measuring the exact moment and sensitive dynamics of the eye. • The second one is a non-contact optical system, in which infrared light is reflected from the eye which is sensed by the video camera. It is used for measuring the eye motion. • And the third one is electrodes, which are placed around the eye uses electro potential is used for measuring the slow eye moment and detecting the gaze direction. Both positive and negative electrodes placed around an eye are called as "ELECTROOCULAGRAM" (EOG). The most popular variant uses video images from which the eye position is extracted. Other methods use search coils or are based on the electrooculogram. Generally, there are two types of eye tracking techniques, which are Bright Pupil and Dark pupil. Difference between these techniques is ON-Axis lighting and OFFAxis lighting between camera and reflection of the light path from the eye.

1.2 Tracker Types

Eye trackers measure rotations of the eye in one of several ways, but principally they fall into three categories:

Fig.1.1-Rotation in Eye

1). One type uses an attachment to the eye, such as a special contact lens with an embedded mirror or magnetic field sensor, and the movement of the attachment is measured with the assumption that it does not slip significantly as the eye rotates. Measurements with tight-fitting contact lenses have provided extremely sensitive recordings of an eye the dynamics and underlying physiology of eye movement.

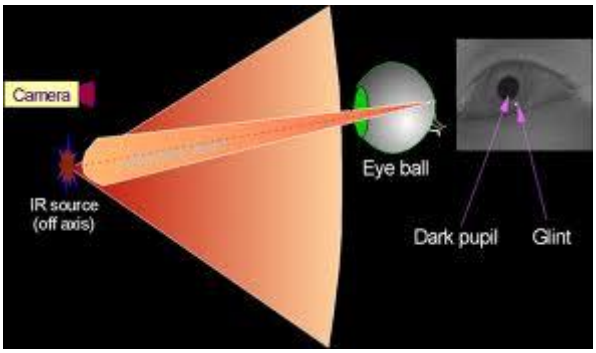

Fig.1.2-Sensor

2). The second broad category uses some non-contact, optical method for measuring eye motion. Light, typically infrared, is reflected from the eye and sensed by a video camera or some other specially designed optical sensor. The information is then analyzed to extract eye rotation from changes in reflections. Video-based eye trackers typically use the corneal reflection (the first Purkinje image) and the center of the pupil as features to track over time.

A more sensitive type of eye tracker, the dual-Purkinje eye tracker, uses reflections from the front of the cornea (first Purkinje image) and the back of the lens (fourth Purkinje image) as features to track.

A still more sensitive method of tracking is to image features from inside the eye, such as the retinal blood vessels, and follow these features as the eye rotates. Optical methods, particularly those based on video recording, are widely used for gaze tracking and are favored for being non-invasive and inexpensive.

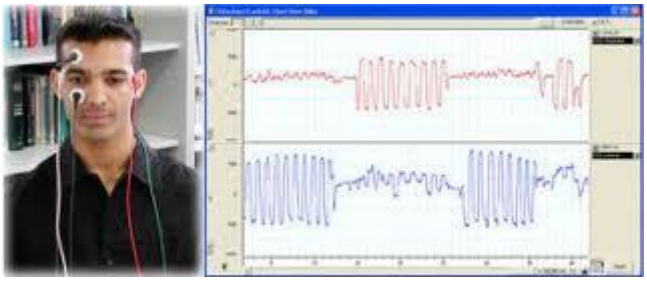

Fig.1.3-EOG of Eye

3). The third category uses electric potentials measured with electrodes placed around the eyes. The eyes are the origin of a steady electric potential field, which can also be detected in total darkness and if the eyes are closed. It can be modeled to be generated by a dipole with its positive pole at the cornea and its negative pole at the retina.

The electric signal that can be derived using two pairs of contact electrodes placed on the skin around one eye is called Electrooculogram (EOG). If the eyes move from the center position toward the periphery, the retina approaches one electrode while the cornea approaches the opposing one.

This change in the orientation of the dipole and consequently the electric potential field results in a change in the measured EOG signal. Inversely, by analyzing these changes in eye movement can be tracked.

Due to the discrete information was given by the common electrode setup two separate movement components – a horizontal and a vertical – can be identified. A third EOG component is the radial EOG channel, which is the average of the EOG channels referenced to some posterior scalp electrode.

A still more sensitive method of tracking is to image features from inside the eye, such as the retinal blood vessels, and follow these features as the eye rotates. Optical methods. This radial EOG channel is sensitive to the saccadic spike potentials stemming from the extra-ocular muscles at the onset of saccades and allows reliable detection of even miniature saccades.

Fig.1.4- Electrooculography

Due to potential drifts and variable relations between the EOG signal amplitudes and the saccade sizes make it challenging to use EOG for measuring slow eye movement and detecting gaze direction. EOG is, however, a very robust technique for measuring saccadic eye movement associated with gaze shifts and detecting blinks.

Contrary to video-based eye-trackers, EOG allows recording of eye movements even with eyes closed, and can thus be used in sleep research. It is a very light-weight

approach that, in contrast to current video-based eye trackers, only requires very low computational power, works under different lighting conditions and can be implemented as an embedded, self-contained wearable system. It is thus the method of choice for measuring eye movement in mobile daily-life situations and REM phases during sleep.

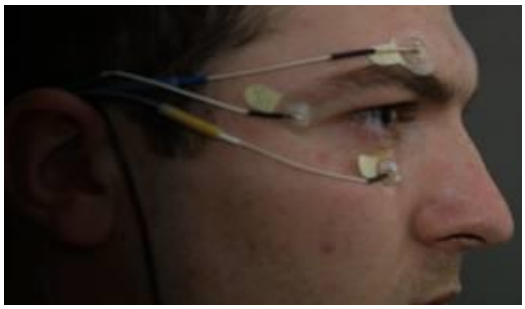

Fig.1.5- Close-up of Electrooculography

2. METHODS AND MATERIAL

- Eye Camera: The PlayStation Eye (trademarked PLAYSTATION Eye) is a digital camera device, similar to a webcam, for the PlayStation 3. The technology uses computer vision and gesture recognition to process images taken by the camera. This allows players to interact with games using motion and color detection as well as sound through its built-in microphone array. It is the successor to the Eye Toy for the PlayStation 2, which was released in 2003.The peripheral was launched in a bundle with The Eye of Judgment in the United States on October 23, 2007, in Japan and Australia on October 25, 2007 and in Europe on October 26, 2007.The PlayStation Eye was also released as a stand-alone product in the United States, Europe and Australia. Eye Toy designer Richard Marks stated that the Eye Toy was used as a model for the rough cost design. The PlayStation Eye is capable of capturing standard video with frame rates of 60 hertz at a 640×480 pixel resolution, and 120 hertz at 320×240 pixels which is "four times the resolution" and "two times the framerate" of the Eye Toy, according to Sony. Higher frame rate, up to 320×240@187 or 640×480@75 fps, can be selected by specific applications (Free track and Linux track).The PlayStation Eye also has "two times the sensitivity" of the Eye Toy, with Sony collaborating with sensor chip partner OmniVision Technologies on a sensor chip design using larger sensor pixels, allowing more effective low-light operation. Sony states that the PlayStation Eye can produce "reasonable quality video" under the illumination provided by a television set. The camera features a twosetting adjustable fixed-focus zoom lens. Selected manually by rotating the lens barrel, the PlayStation Eye can be set to a 56° field of view (red dot) similar to that of the Eye Toy, for close-up framing in chat applications, or a 75° field of view (blue dot) for long-shot framing in interactive physical gaming applications. The PlayStation Eye is capable of outputting video to the console uncompressed.

- CL Eye-Driver: This provides users a signed hardware driver which exposes supported cameras to third party applications such as Adobe Flash, Skype, MSN or Yahoo for video chat or conferencing. Two modes allow basic compatibility mode and a advanced mode for high frame rate development use.

- ITU Gaze Tracker: The ITU Gaze Tracker is an open-source eye tracker that aims to provide a low-cost alternative to commercial gaze tracking systems and to make this technology more accessible. It is developed by the Gaze Group at the IT University of Copenhagen and other contributors from the community, with the support of the Communication by Gaze Interaction Association (COGAIN). The eye tracking software is video-based, and any camera equipped with infrared night vision can be used, such as a video camera or a webcam. The cameras that have been tested with the system can be found in our forum. We encourage users and developers to test our software with their cameras and provide feedback so can continue development.

- IR LED: An IR LED (infrared light emitting diode) is a solid state lighting (SSL) device that emits light in the infrared range of the electromagnetic radiation spectrum used with infrared cameras, IR LED's can act like a spot light while remaining invisible to the naked eye. Infrared (IR) LED's are most often the types of lights used in remote control devices and in security systems across the globe, including covert devices used by the US Military. Infrared LED's are typically used in security cameras, to allow cameras to capture both day and nighttime images.

- Photographic Film: Photographic film is a strip or sheet of transparent plastic film base coated on one side with a gelatine emulsion containing microscopically small light-sensitive silver halide crystals. The sizes and other characteristics of the crystals determine the sensitivity, contrast and resolution of the film. The emulsion will gradually darken if left exposed to light, but the process is too slow and incomplete to be of any practical use. Instead, a very short exposure to the image formed by a camera lens is used to produce only a very slight chemical change, proportional to the amount of light absorbed by each crystal. This creates an invisible latent image in the emulsion, which can be chemically developed into a visible photograph. In addition to visible light, all films are sensitive to ultraviolet, X-rays and high energy particles. Unmodified silver halide crystals are sensitive only to the blue part of the visible spectrum, producing

unnatural-looking renditions of some colored subjects. This problem was resolved with the discovery that certain dyes, called sensitizing dyes, when adsorbed onto the silver halide crystals made them respond to other colors as well. First orthochromatic (sensitive to blue and green) and finally panchromatic (sensitive to all visible colors) films were developed. Panchromatic film renders all colors in shades of gray approximately matching their subjective brightness. By similar techniques, specialpurpose films can be made sensitive to the infrared (IR) region of the spectrum.

- Camera Lens: A camera lens (also known as photographic lens or photographic objective) is an optical lens or assembly of lenses used in conjunction with a camera body and mechanism to make images of objects either on photographic film or on other media capable of storing an image chemically or electronically. There is no major difference in principle between a lens used for a still camera, a video camera, a telescope, a microscope, or other apparatus, but the detailed design and construction are different. A lens might be permanently fixed to a camera, or it might be interchangeable with lenses of different focal lengths, apertures, and other properties. While in principle a simple convex lens will suffice, in practice a compound lens made up of a number of optical lens elements is required to correct (as much as possible) the many optical aberrations that arise. Some aberrations will be present in any lens system. It is the job of the lens designer to balance these and produce a design that is suitable for photographic use and possibly mass production.

- Connecting Wires: A wire is a single, usually cylindrical, flexible strand or rod of metal. Wires are used to bear mechanical loads or electricity and telecommunications signals. Wire is commonly formed by drawing the metal through a hole in a die or draw plate. Wire comes in solid core, stranded, or braided forms.

- Rechargeable Battery: A rechargeable battery, storage battery, secondary cell, or accumulator is a type of electrical battery which can be charged, discharged into a load, and recharged many times, as opposed to a disposable or primary battery, which is supplied fully charged and discarded after use. It is composed of one or more electrochemical cells. The term "accumulator" is used as it accumulates and stores energy through a reversible electrochemical reaction. Rechargeable batteries are produced in many different shapes and sizes.

3. RESULT AND DISCUSSION

The Eye-Writer software consists of following functional modules: eye-tracking, gaze detection and drawing. It is designed for drawing and writing with eye movement using the Eye-Writer. The software for both parts has been developed using Open Frameworks, a cross platform c++ library for creative development. The eye-tracking software detects and tracks the gaze point from an incoming camera or video image, and uses a calibration sequence to map the tracked pupil coordinates to positions on a computer screen or projection. The pupil tracking is done on base of bright or dark pupil. The Eye tracking lens we designed use IR illumination to illuminate the eye and create a dark pupil effect. This makes the pupil much more clear and visible and thus, easy to track.

The camera setting some portion of the software which is planned so the picture can be balanced with splendour and differentiation to get an ideal picture of the eye.

3. CONCLUSIONS

- It is a boon to the disabled people who are suffering from ALS(Amyotrophic Lateral Sclerosis), and other degenerative neuromuscular diseases, using reliable, cost effective and creative technologies.
- It is used for various research & development and studies conducted in exploring many fields of science and technology
- The position and the movement of the eye(or pupil) can be tracked and thus the desired result is visualized on the screen(monitor) provided, which would enable us to read human thoughts.
- A 100% efficiency has not been achieved yet but researchers sure assure that such a high efficiency eye writer is just around the corner.
- Soon these eye writers will be affordable for even the common man to his advantage.

REFERENCES

[1] Stiefelhagen, Rainer, Jie Yang, and Alex Waibel. "Tracking eyes and monitoring eye gaze." Proc. Workshop on Perceptual User Interfaces. 1997.

[2] Salvucci, Dario D., and Joseph H. Goldberg. "Identifying fixations and saccades in eyetracking protocols." Proceedings of the 2000

[3] Holmqvist, Kenneth, et al. Eye tracking: A comprehensive guide to methods and measures. OUP Oxford, 2011.

[4] Jacob, Robert JK, and Keith S. Karn. "Eye tracking in human-computer interaction and usability research: Ready to deliver the promises." The mind's eye. 2003. 573-605.

[5] Poole, Alex, and Linden J. Ball. "Eye tracking in HCI and usability research." Encyclopedia of human-computer interaction. IGI Global, 2006. 211-219.

[6] Morimoto, Carlos H., and Marcio RM Mimica. "Eye gaze tracking techniques for interactive applications." Computer vision and image understanding 98.1 (2005): 4-24.

[7] Ebisawa, Yoshinobu. "Improved video-based eye-gaze detection method." Instrumentation and

Measurement Technology Conference, 1994. IMTC/94. Conference Proceedings. 10th Anniversary. Advanced Technologies in I & M., 1994 IEEE. IEEE, 1994.

[8] Kim, Kyung-Nam, and R. S. Ramakrishna. "Vision-based eye-gaze tracking for humancomputer interface." Systems, Man, and Cybernetics, 1999. IEEE SMC'99 Conference Proceedings. 1999 IEEE International Conference on. Vol. 2. IEEE, 1999